PHARMACEUTICAL ANALYSIS – BP102T

UNIT: V ELECTRO ANALYTICAL METHOD OF ANALYSIS

CLASS:39

TOPIC: ELECTROCHEMICAL CELL-HYDROGEN ELECTRODE

POTENTIOMETRY:

The potential of one electrode—the working or indicator electrode—responds to the analyte's activity, and the other electrode—the counter or reference electrode—has a known, fixed potential**.**

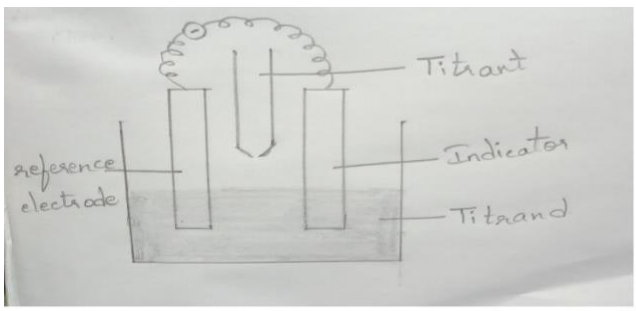
The electrochemical cell consists of two half-cells, each containing an electrode immersed in a solution of ions whose activities determine the electrode's potential.

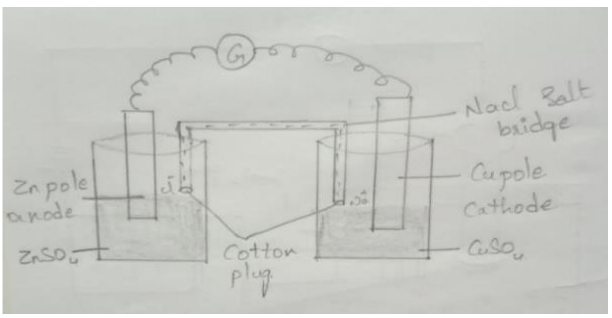
A salt bridge containing an inert electrolyte, such as KCl, connects the two half-cells.

The ends of the salt bridge are fixed with porous frits, allowing the electrolyte's ions to move freely between the half-cells and the salt bridge.

This movement of ions in the salt bridge completes the electrical circuit.

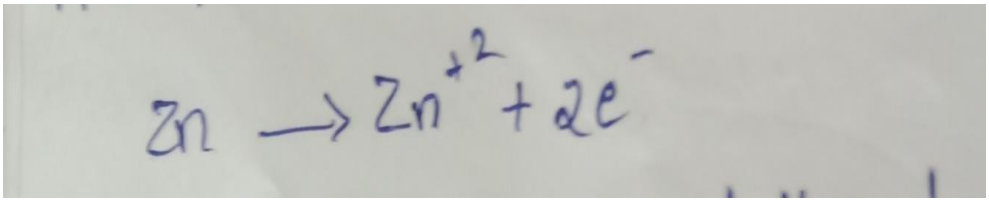
Electro chemical cell:

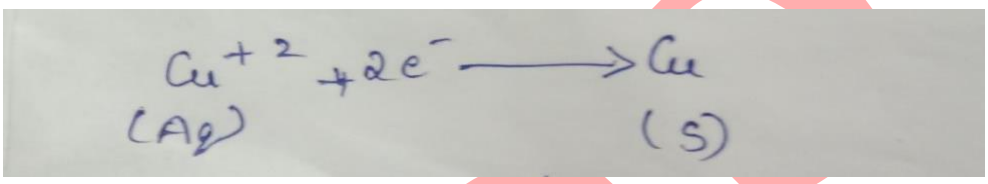




Cell is a small device which is used to convert from one energy to another energy.At anode, Oxidation takes place

At cathode, Reduction takes place





Reference Electrodes:

Ideal reference electrode-

• Has a potential that is accurately known and constant

• Completely insensitive to composition of the analyte solution

• Electrode should be rugged

• Easy to assemble

• Should maintain a constant potential while passing minimal currents

• For example, calomel reference electrodes

• Consists of mercury in contact with a solution that is saturated with mercury chloride (calomel) and also contains a known concentration of potassium chloride

Standard Hydrogen Electrode:

This can be used as reference electrode as well as Indicator electrode.

Note:-

1.Reference electrode is a standard electrode and having constant potential and won't changewith the environment.

2.Indicator electrode is the electrode which changes potential according to theenvironment we apply

3.It is considered as a primary reference electrode because of it is used to determine thepotential of other electrodes.

It is acting as Indicator electrode when dip in analyte or sample solution.

It is acting as reference electrode when it is dip in standard electrode solution.

Construction:

• Consists of a glass tube having holes at its bottom

• Inside this tube is another glass tube having a platinum or copper wire with a platinum foil

• Surface of platinum foil is coated electrically with platinum black

• Pure hydrogen gas at 1 atmospheric pressure is passed through opening of glass tube

• And it escapes through small holes at the bottom of the electrode

• Electrode is dipped in a solution of standard acid like hydrochloric acid of unit activity (1.8 M of HCl at 25 0C)

• Some hydrogen gas is absorbed by platinum black of electrode and it permits the exchange from gaseous to ionic of hydrogen

• Also reverse the process to occur without any obstacle

• Under fixed conditions of pressure of hydrogen gas passed and hydrogen ions in solution with
contact of electrode, hydrogen electrode possess a definite potential

• By convention, this potential is taken as zero at all temperature

• When normal hydrogen electrode is connected to any electrode through salt bridge, potential of that electrode can be measured

• For example, zinc electrode (zinc metal rod in contact with a solution of zinc ion) is connected by potassium chloride salt bridge, can be represented as

• Pt, H2 |H+ (a=1)|| Zn+2 || Zn

• Where a is unknown

• Cell reaction is

• $H2 + Zn^{+2}$ à $2H+ (a=1) + Zn$

• Similar way, we can measure the potential of any electrode

• Potential of a hydrogen electrode depends upon the pH value of a solution which it is contact

• pH value of a given solution can be calculated by combining with normal hydrogen electrode (NHE) or with any standard reference electrode like saturated calomel electrode

Advantages:

• Fundamental electrode and is used as standard in pH measurements

• Can be used over wide pH range

• Exhibits no salt error

• Establishes equilibrium rapidly and gives accurate results

Disadvantages

• Cannot be used in solutions containing strong oxidizing or reducing agents

• Cannot be used in solutions containing metal ions that below hydrogen in potential series

• Interaction with hydrogen will occur and the metal will be deposited on electrode surface

• Gets readily poisoned by number of substances like proteins, tannins, mercury salts, etc

• Cumbersome to prepare and use in routine analysis

• Because of its cumbersomeness, it is replaced by other standard electrodes